Ascending and Descending Tracts

SMS 1084

Dr. Mohanad R. Alwan
Contents

- function of nervous system in general
  - sensory system overview
  - spinal cord and nerve tracts
    - ascending tracts
      - organization in general
      - ascending tracts
      - functional components
Nervous System
Communication

receive information
transform it into impulses (transduction)
transmit impulses to the CNS
correlate / coordinate
transmit impulses to the effector organs
response / action
CENTRAL NERVOUS SYSTEM

integration / processing / modulating

motor / descending tracts

sensory / ascending tracts

lower motor neurone

PNS transmission

receptor neurone

stimulus

effector organ / response
Ascending Tracts

bundles of nerve fibres
linking
spinal cord with higher centres of the brain
convey information
from
soma / viscera to higher level of neuraxis (CNS)
Ascending Sensory Pathway are organized in three neuronal chain

- First order neurone
- Second order neurone
- Third order neurone
First order neurone

- cell body in **posterior root ganglion**
- peripheral process connects with sensory receptor ending
- central process enter the spinal cord through the posterior root
- synapse with second order neuron in spinal gray matter
dorsal root
dorsal root ganglion
spinal nerve
dorsal horn

FIRST ORDER NEURON
Second order neurone

• cell body in **posterior gray column of spinal cord**

• **axon crosses the midline (decussate)**

• ascend & synapse with third order neuron in VPL nucleus of thalamus
SECOND ORDER NEURON

- cross the mid line
- in front of central canal
Third order neurone

- cell body in the **thalamus**
- give rise to projection fibres to the cerebral cortex, postcentral gyrus (sensory area)
ascending sensory pathway
(in general form)
from sensory endings
to
cerebral cortex
(note the three neurons chain)
Ascending tracts

- Fasciculus gracilis
- Fasciculus cuneatus
- Dorsal spinocerebellar tract
- Ventral spinocerebellar tract
- Spinothalamic tract

ascending tracts in spinal cord
lateral spinothalamic tract
  pain, temperature

anterior spinothalamic tract
  touch, pressure
● posterior white column
  – conscious proprioceptive sense, discriminative touch, vibratory sense

● spinocerebellar tract / cuneocerebellar tract
  – unconscious information from muscle, joints, skin, subcutaneous tissues
Lateral spinothalamic tract

- pain and thermal impulses
  (input from free nerve endings, thermal receptors)

- transmitted to spinal cord in delta A and C fibres

- central process enters the spinal cord through posterior nerve root, proceed to the tip of the dorsal gray column
pain and temperature pathways
Anterior spinothalamic tract
light touch and pressure impulses
( input from free nerve endings, Merkel’s tactile disks )

- First order neuron
  - dorsal root ganglion (all level)

- Second order neuron
  - in the dorsal horn, cross to the opposite side (decussate)
  - ascend in the contralateral ventral column
  - end in VPL nucleus of thalamus

- Third order neuron
  - in the VPL nucleus of thalamus
  - project to cerebral cortex (area 3, 1 and 2)
Touch and pressure pathways
Posterior & anterior spinocerebellar tract

- Transmit unconscious proprioceptive information to the cerebellum

- receive input from muscle spindles, and pressure receptors

- involved in coordination of posture and movement of individual muscles of the lower limb
muscle joint sense pathways to cerebellum
• **Spinotectal tract**
  - passes pain, thermal, tactile information to superior colliculus for **spinovisual reflexes**
    - cross the median plane
    - synapse in the superior colliculus
    - integrate visual and somatic sensory information (it brings about the movement of eye and head towards the source of information)

• **Spinoreticular tract**
  - uncrossed fibres, synapse with neurones of reticular formation
    (important role in influencing **level of consciousness**)

• **Spino-olivary tract**
Descending Tracts

- Segregated bundles of nerve fibres in the white matter of the spinal cord descending from the supraspinal centres referred to as upper motor neurons (UMN)
- are concerned with somatic and visceral motor activity
- cells of origin lie in cerebral cortex and brain stem
- regulate the LMN activity
motor homunculus
cerebral cortex
**lower motor neurons (LMN)**

Motor neurons that innervate the voluntary muscles:
- In anterior gray column of spinal cord
- Motor nuclei of brainstem
  - Innervate skeletal muscles

Form **final common pathway**
constantly bombarded by

- nerve impulses (excitatory or inhibitory) that descend from cerebral cortex, pons, midbrain and medulla

- sensory inputs from the posterior root
Upper motor neurons (UMN)

- The descending supraspinal pathways that influence the activity of the LMN
UMN

- control voluntary motor activity
- maintenance of posture & equilibrium
- control of muscle tone and reflex activity

Generally exerts their effect

- on groups of muscles (not on one specific muscle)
- reciprocally on agonist and antagonist muscle group
Corticospinal tract

- arises from the pyramidal cells of cerebral cortex
  - fibres travel through
    - corona radiata
    - posterior limb of the internal capsule
    - cerebral peduncle (middle 3/5th)
    - pons
    - medulla oblongata (passed through the pyramids)
  - eventually fibres cross the mid line and terminate on LMN of anterior gray column of respective spinal cord segments
Pyramidal tract

- Aka ‘Corticospinal tract’.
- Massive bundle of axons that connect cortex to spinal cord.
- Mostly voluntary motor control.

http://library.med.utah.edu/kw/hyperbrain/syllabus/syllabus10.html
motor decussation
medulla oblongata
Corticospinal Tract
for fine skilled movements
Rubrospinal tract

- nerve cells in red nucleus (tegmentum of midbrain at the level of superior colliculus)
- nerve fibres / axons
  - cross the mid line
  - descend as rubrospinal tract
    - through pons and medulla oblongata
- terminate anterior gray column of spinal cord
  
  (facilitate the activity of flexor muscles)
1-6. Rubrospinal tract.
Tectospinal tract

- nerve cells in superior colliculus of the midbrain

- nerve fibres/axons
  - cross the mid line
  - descend close to medial longitudinal fasciculus

- terminate in the anterior gray column of upper cervical segments of spinal cord

( responsible for reflex movement of head & neck in response to visual stimuli )
Tectospinal tract.
Vestibulospinal tract

- nerve cells in vestibular nucleus (in the pons and medulla oblongata)
  - received afferents from inner ear and cerebellum

- axons descend **uncrossed**
  - through medulla and through the length of spinal cord

- synapse with neuron in the anterior gray column of the spinal cord

( *balance by facilitate the activity of the extensor muscles* )
Reticulospinal tract

- nerve cells in reticular formation
- fibres pass through
  - midbrain, pons, and medulla oblongata
- end at the anterior gray column of spinal cord
  - control activity of motor neurons

(influence voluntary movement and reflex activity)
THANK YOU

I need a Chiropractor!

Please